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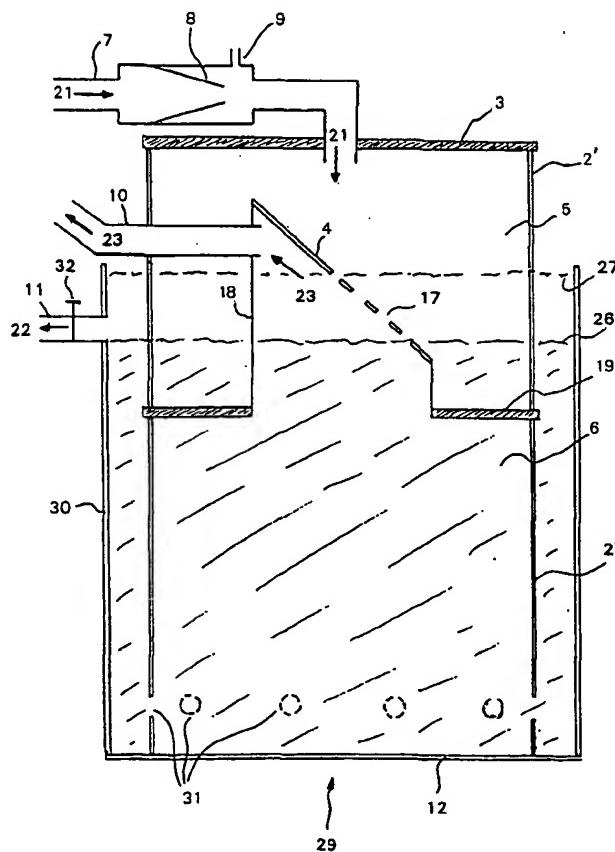
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(54) Title: PURIFICATION DEVICE FOR PURIFYING FRESH WATER

**(57) Abstract**

Purification device (1, 16, 29) for removing foam-forming contaminants from fresh water, comprising a vertically placeable tubular housing (2, 2', 2'') which housing, in vertical position, - is provided on its top side with a closing cover (3), is divided by a grating (4) into an upper compartment (5) and a lower compartment (6), wherein the upper compartment is provided with an inlet channel (7) for water for purifying debouching above the level of the grating (4) and with air inlet means (8, 9) for admitting air into the upper compartment (5) during operation of the device (1, 16) in order to build up an overpressure relative to the ambient pressure of the device, and wherein the lower compartment (6) is provided with a first outlet channel (10) for foam and a second outlet channel (11) for purified water.



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**PURIFICATION DEVICE FOR PURIFYING FRESH WATER**

The invention relates to a purification device for removing foam-forming contaminants from fresh water.

Such a device can be applied for instance to remove proteins from fresh water aquariums and ponds. Feeding

- 5 of fish kept in fresh water aquariums or small ponds results in contamination of the environment of these fish by proteins in that not all the supplied food is taken up or fully digested. Protein residues result in the creation of bacteria which degrade and convert the  
10 proteins into inorganic compounds which enhance algal growth, which results in oxygen-shortage and eventually in fish death.

- A purification device is known substantially comprising a biological and mechanical filter. In the  
15 known device contaminating particles in water are removed using a filter material. On this filter material grow bacteria which degrade organic substances, for instance proteins, into inorganic substances, for instance nitrates.

- 20 It is a drawback of the known purification device that the growth of an effective bacteria culture involves a comparatively long period of time, for instance a period of two months. During this period there occur only partly degraded nitrogen compounds  
25 which are particularly toxic for fish. The known purification device must therefore be cleaned regularly, which has the consequence however that the grown bacteria disappear.

- It is an object of the invention to provide a  
30 purification device using which foam-forming contaminants, particularly proteins, can be removed from fresh water without substances herein being released which are immediately hazardous for fish and other fresh water animals or substances which enhance algal growth.

It is a further object to provide a purification device of simple construction which requires no or at least negligible maintenance, and the maintenance and operating costs of which are relatively low.

- 5        These objectives are realized, and other advantages gained, with a purification device for removing foam-forming contaminants from fresh water, comprising a vertically placeable tubular housing, which hosing, in vertical position,
- 10      - is provided on its top side with a closing cover,  
          - is divided by a grating into an upper compartment and a lower compartment, wherein  
            - the upper compartment is provided with an inlet channel for water for purifying debouching above the  
15      level of the grating and with air inlet means for admitting air into the upper compartment during operation of the device in order to build up an overpressure relative to the ambient pressure of the device, and wherein  
20      - the lower compartment is provided with a first outlet channel for foam and a second outlet channel for purified water.

When water is admitted into the first compartment in such a purification device air bubbles are created  
25      which are rich in the contaminants present in the water which have adhered to these air bubbles under the influence of occurring phenomena of surface adsorption. Applying a low overpressure in the device results in a long lifespan of the air bubbles such that the air  
30      bubbles can be discharged in the form of contaminated foam from the device via the first outlet channel. Due to the foam-formation for instance proteins, lipids, cellulose, algae, parasites, dyes, softening agents and chemicals originating from medicines are removed from  
35      the water. The foam herein acts as a self-cleaning mechanical filter, using which fine contaminating particles are filtered out of the water. The purified

water, at least the water with a decreased content of contaminants, can be added via the second outlet channel to the water mass from which it was originally supplied to the purification device. The concept of "tubular

5 housing" in this invention is not limited to a hollow cylinder but comprises in principle any encasing structure closing onto itself in cross-section, such as structures which are rectangular and square or otherwise regular in cross-section.

10 In an advantageous embodiment the air inlet means comprise a venturi constriction and an opening provided downstream thereof in the inlet channel.

In this embodiment the supplied water for purifying as it were itself entrains the air required to form and  
15 sustain foam.

In yet another embodiment the grating is a plate provided with apertures, wherein the diameter of the apertures lies for instance in the range of 6 to 7 mm.

20 In an embodiment the housing is closed on its underside by a bottom.

In a subsequent embodiment the housing is open on its underside and can be placed vertically with this open underside into the liquid level of a quantity of purified water, wherein the open underside forms the  
25 second outlet channel, and wherein the housing is provided for instance with floating means for causing the housing to float in vertical position in the quantity of purified water.

30 In an advantageous embodiment the grating is placed obliquely when the housing is placed vertically and the first outlet channel extends from just beneath the highest placed part of the grating.

It has been found that an obliquely placed grating enhances both foam formation and a good passage of foam  
35 from the first to the second compartment.

The operation of the device is enhanced even further if the first compartment contains a filter material, for instance a quantity of granular material.

Any waterproof material is in principle suitable as 5 material for the housing, for instance stainless steel or a plastic such as polyvinyl chloride (PVC).

In a particularly practical embodiment the housing is manufactured from a transparent material, for instance an acryl material, so that the operation of the 10 device is directly visible.

The invention will be elucidated hereinbelow on the basis of embodiments and with reference to the annexed drawings.

In the drawings:

15 Fig. 1 shows in longitudinal section a first embodiment of a purification device according to the invention, and

Fig. 2 shows in longitudinal section a second embodiment of a purification device according to the 20 invention,

Fig. 3 shows the device of fig. 2 in top view,

Fig. 4 shows a detail of the device of fig. 2 in top view, and

Fig. 5 shows in longitudinal section a third 25 embodiment of a purification device according to the invention.

Corresponding components are designated in the drawing with the same reference numerals.

Fig. 1 shows a foam-removing device 1 with a 30 tubular housing 2 which is provided with a cover 3 and a bottom 12. A grating 4 divides device 1 into an upper compartment 5, which is provided with an inlet channel 7 debouching above grating 4, and a lower compartment 6 which is provided with a foam outlet channel 10 and a 35 water outlet channel 11. In inlet channel 7 is arranged a venturi constriction 8, at the rear of which debouches an air inlet channel 9 through which air can be drawn

in. The figure further shows an air inlet 13 in water outlet channel 11, a return channel 14 in foam outlet channel 10 and a layer of coarse-grained material 15, so-called hydrogranules.

5       The operation of device 1 is as follows. Using a water pump (not shown) water contaminated with foam-forming substances (particularly proteins) is admitted via inlet channel 7 (as according to arrow 21) and falls onto grating 4, wherein foam is formed. The formation of  
10      foam is further enhanced in that the water drops onto grating 4 via the underside of cover 3 and the coarse-grained material 15. The formed foam, which is rich in contaminants, and the purified water, which has a relatively low level of contaminants, sink through the  
15      grating to the second compartment 6, from where the foam is discharged via foam outlet channel 10 (as according to arrows 23) and the water via water outlet channel 11 (as according to arrows 22). A slight overpressure in housing 2, which is a result of air being drawn in via  
20      inlet channel 9, herein prevents the air bubbles in the foam bursting prematurely. Excess water from the discharged foam runs back into the second compartment 6 via return channel 14. When the water outlet channel 11 is sufficiently large, the maximum height 27 of the  
25      liquid level in second compartment 6 is defined by the highest point of this channel 11. Admittance of air via air inlet 13 prevents the liquid level in the second compartment 6 sinking below a minimum height 26 as a consequence of a siphoning effect of water outlet  
30      channel 11. This prevents foam being discharged (if the liquid level drops even further) from the second compartment 6 via water outlet channel 11.

Fig. 2 shows an alternative embodiment of a foam-removing device 16. Tubular housing 2', 2" is provided  
35      with fixing eyes 20 with which the device can be suspended vertically in the liquid surface 24 of a quantity of water for purifying, for instance in a pond

- or an aquarium. Grating 4 in this device is a plate provided with holes 17 and arranged on a slantwise cut upper end of a vertical inner tube 18 which is connected on its straight cut lower end to an annular plateau 19
- 5 received between two parts 2', 2" of the tubular housing of device 16. A foam outlet channel 10 extends from just below the highest placed part of grating 4. Housing 2', 2" has an open underside which forms the water outlet channel 11.
- 10 The operation of device 16 is analogous to that of device 1 of fig. 1, with the understanding that the bottom of second compartment 6 is formed by the water level 25 inside housing 2', 2". The overpressure in the device, which is a consequence of air being drawn in via
- 15 inlet channel 9, can result in a difference in the water level 24 outside housing 2', 2" and the water level 25 inside housing 2', 2".

Fig. 3 shows device 16 of fig. 2 in top view. Water inlet channel 7 is branched in a manner such that

20 branches 7', 7" extend to a position above annular plateau 19 in order to enhance forming of the greatest possible quantity of foam.

Fig. 4 shows device 16 in a top view from the level of broken line IV-IV in fig. 2. The grating 4 is a

25 plate, in the right-hand part of which are arranged apertures 17 with a diameter of about 6-7 mm, through which foam is driven from first compartment 5 to second compartment 6, where it accumulates below the highest placed (closed) left-hand part of grating 4 and can be

30 discharged via the foam outlet channel 10 debouching just below that part.

Fig. 5 shows a third embodiment 29 practically identical to the foam-removing device 16 shown in fig. 2 but differing therefrom in that apertures 32 are formed

35 in the underside of tube 2' and tube 2' is closed on the underside by a bottom 12 which extends beyond tube 2' and from which an outer tube 30 extends concentrically

to tubes 2', 2". Water entering the lower compartment 6 through grating 4 is discharged via apertures 31 to the space between tubes 2', 2" and 30, from where it is pushed upward to a minimum level 26 defined by a water 5 outlet channel 11 formed in tube 30 and provided with a control valve 32 or (when said control valve 32 is partially closed) to a maximum level 27 just below the upper edge of outer tube 30. Other than the protein foam-removing device 16 of fig. 2, device 29 of fig. 5 10 can also be placed above and outside the liquid level of a quantity of water for purifying. The presence of a closed bottom 12 moreover enhances rising of formed air bubbles.

It is noted that the described embodiments serve 15 for a better understanding of the invention and not to limit the scope thereof.

Within the framework of the inventive concept, which is defined by the scope of the appended claims, numerous embodiments lie within the reach of the skilled 20 person.

Although the given embodiments are particularly suited for application in cleaning fresh water in aquaria and ponds, a device according to the invention is also suitable for cleaning water in for instance 25 swimming pools, drinking-water reservoirs or wastewater purification plants. Such a device is advantageously applied in combination with an UV light source or an ozone generator to prevent the growth of harmful bacteria.

## CLAIMS

1. Purification device (1, 16, 29) for removing foam-forming contaminants from fresh water, comprising a vertically placeable tubular housing (2, 2', 2") which housing (2, 2', 2"), in vertical position,
  - 5 - is provided on its top side with a closing cover (3),
    - is divided by a grating (4) into an upper compartment (5) and a lower compartment (6), wherein
      - the upper compartment (5) is provided with an inlet channel (7) for water for purifying debouching above the level of the grating (4) and with air inlet means (8, 9) for admitting air into the upper compartment (5) during operation of the device (1, 16) in order to build up an overpressure relative to the ambient pressure of the device (1, 16), and wherein
        - 10 - the lower compartment (6) is provided with a first outlet channel (10) for foam and a second outlet channel (11) for purified water.
  2. Purification device (1, 16, 29) as claimed in claim 1, characterized in that the air inlet means comprise a venturi constriction (8) and an opening (9) provided downstream thereof in the inlet channel (7).
  3. Purification device (1, 16, 29) as claimed in claim 1 or 2, characterized in that the grating (4) is a plate provided with apertures (17).
  4. Purification device (1, 16, 29) as claimed in claim 3, characterized in that the diameter of the apertures (17) lies in the range of 6 to 7 mm.
  5. Purification device (1) as claimed in any of the claims 1-4, characterized in that the housing (2) is closed on its underside by a bottom (12).
  6. Purification device (16) as claimed in any of the claims 1-4, characterized in that the housing (2', 2") is open on its underside and can be placed

vertically with this open underside in the liquid surface (25) of a quantity of purified water, wherein the open underside forms the second outlet channel (11).

7. Purification device (16) as claimed in claim 6,  
5 characterized in that the housing (2', 2") is provided with fixing means (20) for holding the housing (2', 2") in a vertical position in the quantity of purified water.

8. Purification device (29) as claimed in any of  
10 the claims 1-4, characterized in that the housing (2',  
2") is closed on its underside by a bottom (12) which extends beyond this housing (2', 2") and from which extends an outer casing (30) enclosing the housing (2',  
15 2"), wherein in each of the underside of the housing (2') and the top side of outer casing (30) is formed at least one passage opening (31, 11) for purified water.

9. Purification device (16, 29) as claimed in any of the foregoing claims, characterized in that the grating (4) is placed obliquely when the housing (2',  
20 2") is placed vertically and the first outlet channel (10) extends from just beneath the highest placed part of the grating (4).

10. Purification device (1) as claimed in any of the foregoing claims, characterized in that the first  
25 compartment (5) contains a granular material (15).

11. Purification device (1, 16, 29) as claimed in any of the foregoing claims, characterized in that the housing (2, 2', 2") is manufactured from a transparent material.

30 12. Purification device (1, 16, 29) as claimed in any of the foregoing claims, characterized in that the housing (2, 2', 2") is manufactured from an acryl material.

13. Use of a purification device (1, 16, 29) as  
35 claimed in any of the foregoing claims for cleaning fresh water in combination with a UV light source.

10

14. Use of a purification device (1, 16, 29) as claimed in any of the foregoing claims for cleaning fresh water in combination with an ozone generator.

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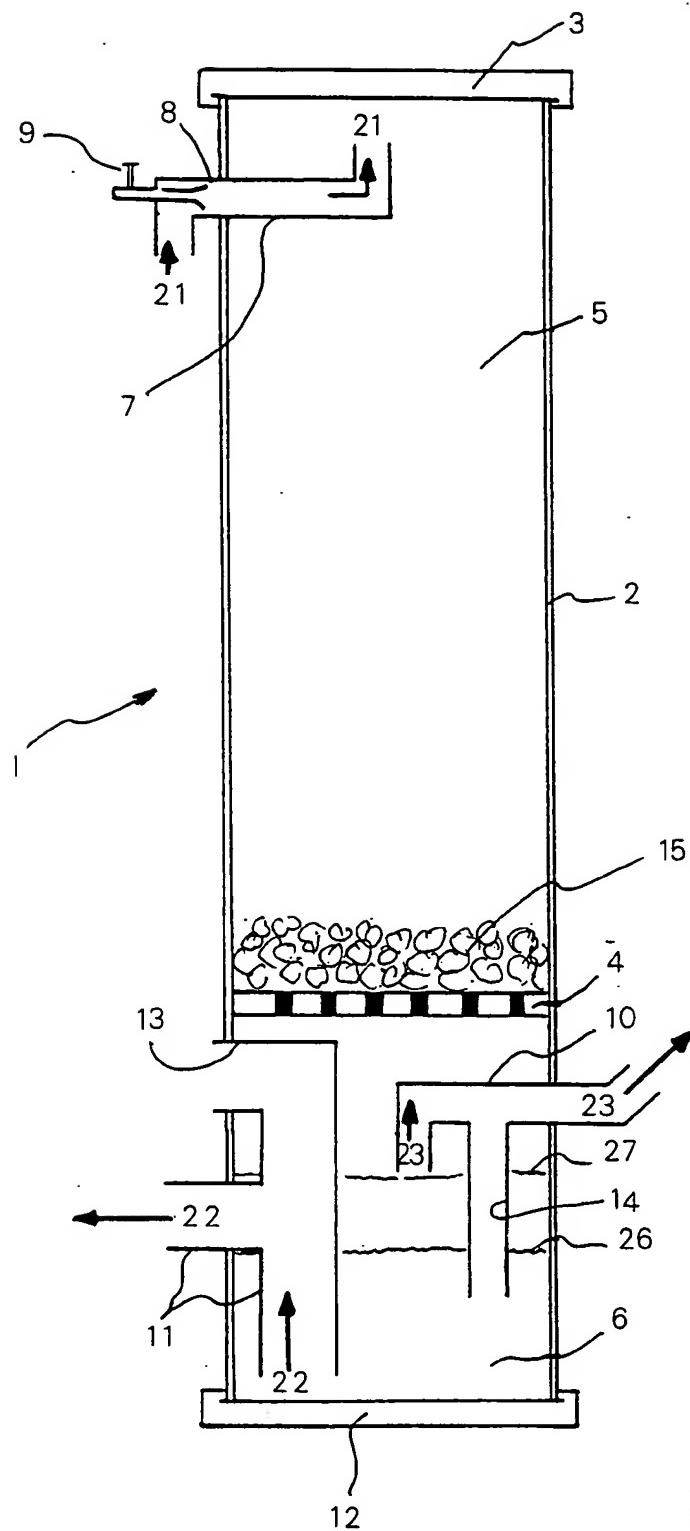


Fig. 1

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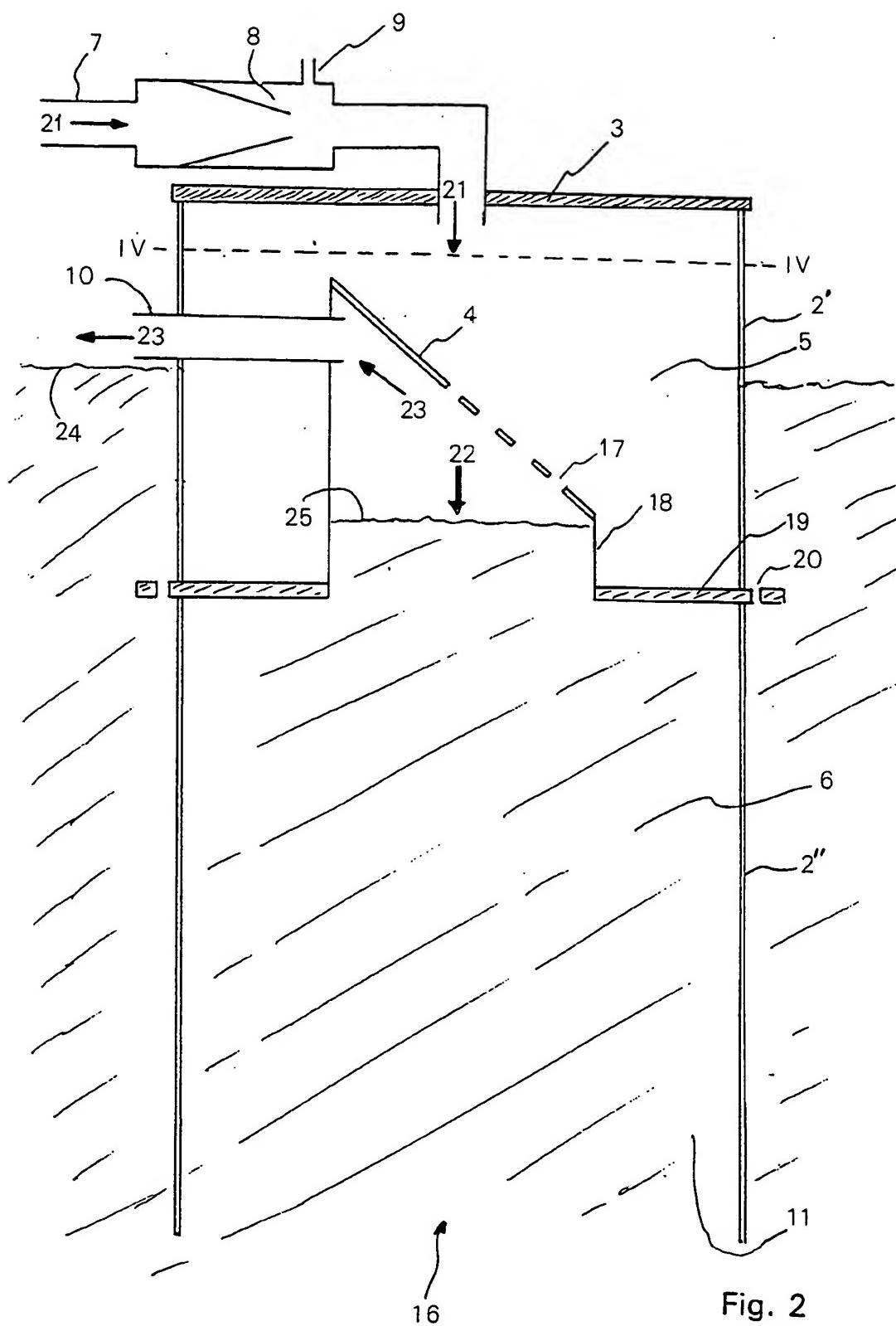


Fig. 2

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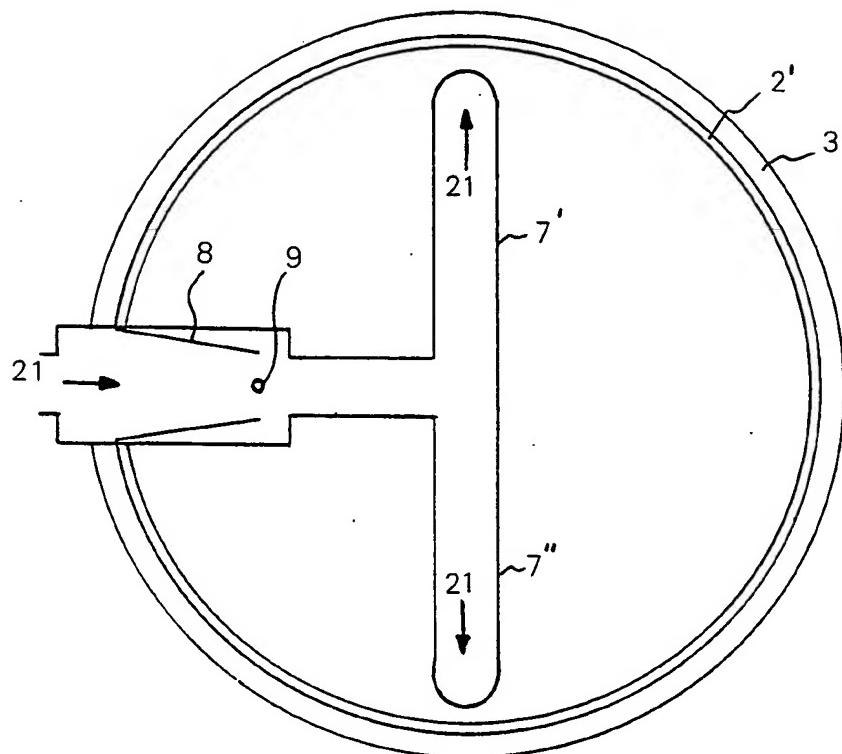


Fig. 3

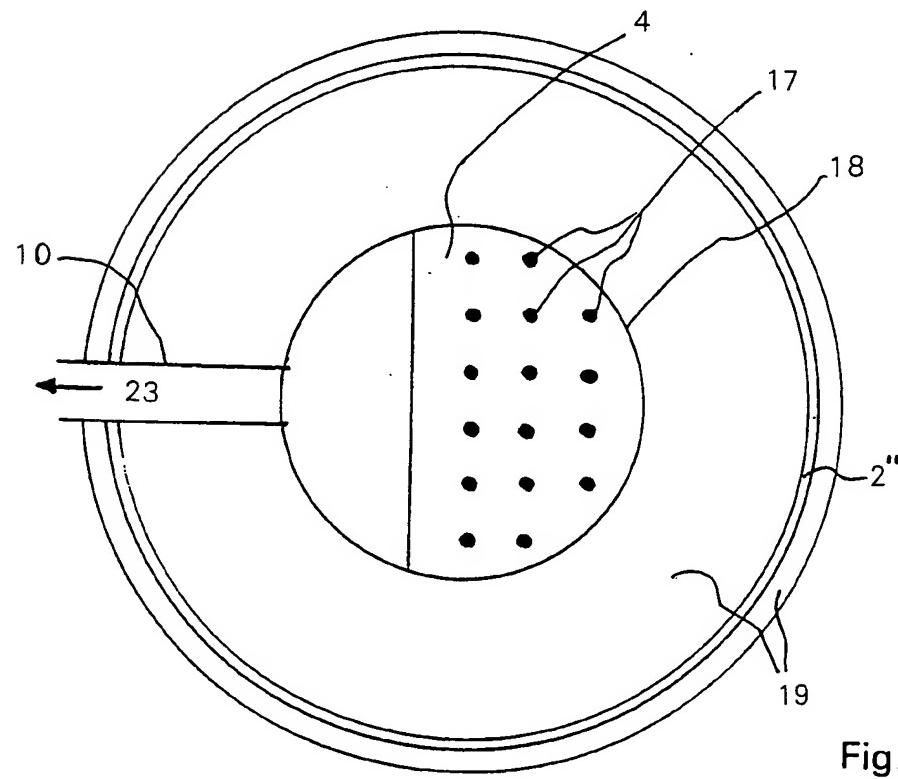


Fig. 4

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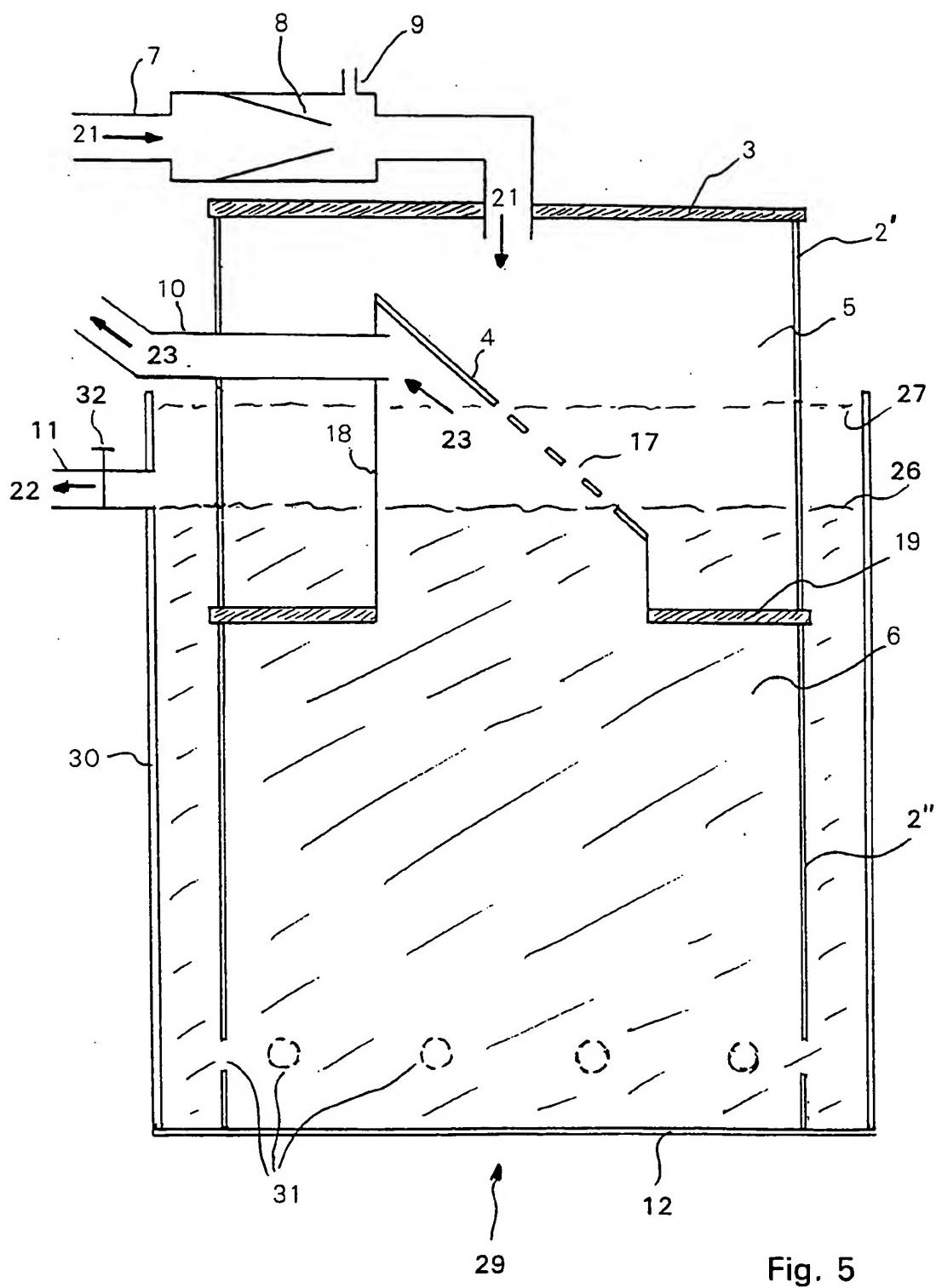


Fig. 5

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 00/00132

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 A01K63/04 C02F3/04

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 7 A01K C02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 96 07618 A (TLOK) 14 March 1996 (1996-03-14)	1, 3, 5,
Y	page 10, line 14 -page 12, line 10; figure 1	10, 12 2
A	—	13, 14
Y	US 3 669 883 A (HUCKSTEDT) 13 June 1972 (1972-06-13)	2
A	abstract; figure 1 —	1
A	US 5 385 665 A (NEUHAUS) 31 January 1995 (1995-01-31) —	

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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